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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(54) Title: A METHOD AND SYSTEM FOR POSITIONING IN A MOBILE COMMUNICATIONS NETWORK
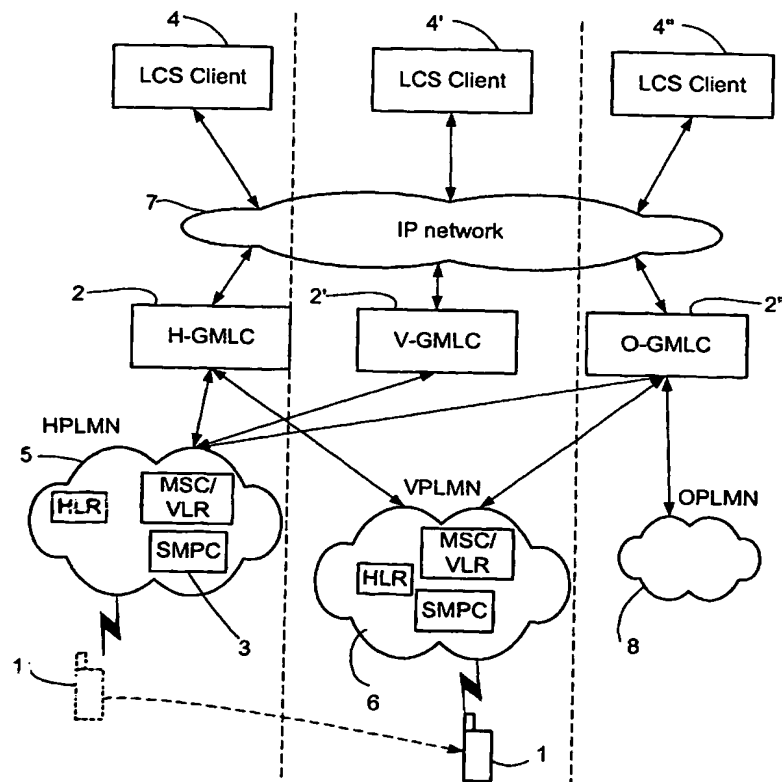
(57) Abstract: A method and system for obtaining the position of a mobile station (1) located in a current network of a communications system including a plurality of networks supporting different positioning protocols. The current network (6) (107) is identified at a location centre (2) based on the identified current network (6), a suitable positioning protocol is selected among at least two protocols for communication of location information with the current network (6) (108).

WO 2004/057905 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A METHOD AND SYSTEM FOR POSITIONING IN A MOBILE COMMUNICATIONS NETWORK

Technical field of the invention

5   The present invention relates to a method and system for obtaining the position of a mobile station in a communications system, and more particularly to a method and system for a location service to obtain the position of a mobile station when located in a current network, 10 wherein a home network, an originating network or said current network may use different mechanisms/protocols for positioning signalling between said networks.

Background of the invention

15   Positioning is the process of geographically locating Mobile Stations (MS) in a Public Land Mobile Network (PLMN) by collecting and analyzing needed information, and after calculating the position, reporting it to an application for further usage.

20   Location-based services are forecasted to be an important feature in mobile communications network. A system for mobile positioning enables an operator to provide location-based services to its customers. Location information is an important enabler for many of the new 25 services in the third generation mobile networks. Also, in some countries there are legal requirements on providing location information when an emergency call is made from an MS.

An ETSI standardised Gateway Mobile Location Centre 30 (GMLC) discloses an example of a vital part of a mobile positioning system. The GMLC is the link between the PLMN and location services clients (LCS-C). It receives the positioning requests, performs the necessary authentication, initiates the positioning in the PLMN, and sends 35 back the positioning information to the requesting application.

The knowledge of the location of a mobile entity opens up a new set of applications and enhance existing

ones. A number of different applications in different fields, such as governmental, operators or commercial applications are and will be provided.

Each target group has its own demands and needs concerning location based services. Governmental use would typically be applicable for public welfare such as emergency calls and infrastructure planning. Operators have the ability for more accurate network planning by applying location information of large groups of mobile users. Commercial applications open up a whole new set of services.

Depending on the type of application it can be run either by an operator or a service provider. The operator is able to offer service providers access to location information, and the operator can also run its own applications. Existing services can be greatly enhanced and new services can be developed, with the knowledge of the geographical position of a mobile entity. The GMLC and a Serving Mobile Location Centre (SMLC) - which collects position information form the communications network and calculates the co-ordinates to be used by the application allows authorized applications, provided by the operator or third parties, to locate an MS using a variety of methods.

One important aspect of positioning is the support for location services (LCS) when mobile subscribers are roaming, i.e when a mobile subscriber is able to travel freely between cells while engaged in a single phone call, and international roaming, which means that the user can use the option of taking its phone abroad and using it in a Visited Public Land Mobile Network (VPLMN).

Another important aspect is that some applications, for example "friend-finder"-like applications, may need to obtain the position of MSs which are subscribers of other PLMNs.

Different PLMNs may support different location and roaming location mechanisms/protocols.

One such roaming location mechanism/protocol, known
in the art, is used when the target MS is not located in
its home PLMN (HPLMN) and SS7 signalling is used between
the HPLMN and a VPLMN. In this mechanism the GMLC of the
5   requesting LCS-C first interrogates the HLR (Home Location
Register) in the home PLMN of the target MS for positio-
ning routing information, i.e the current MSC/VLR (Mobile
Switching Centre/Visitor Location Register) address of the
MS. Then, this MSC/VLR is interrogated for positioning
10   information. The MSC/VLR address can be located in any
PLMN provided that it supports the same SS7 positioning
roaming mechanism and that an SS7 roaming agreement
exists.

Another approach for a roaming location mechanism/
15   protocol is to use the Internet Protocol (IP). In this
mechanism the GMLC of the LCS-C first interrogates the
GMLC in the home PLMN of the target MS for positioning
routing information, i.e in the PLMN where the MS is
currently located. Then, the GMLC of this current PLMN is
20   interrogated for positioning information. The MS can be
located in any PLMN provided that it supports the same IP
positioning roaming mechanism.

In addition to the above described methods, there
also exist proprietary roaming support mechanisms and new
25   proprietary solutions can be anticipated to evolve over
time due to the consolidation of the number of PLMN
operators.

Thus, there will probably exist various
mechanisms/protocols and different operators and vendors
30   will support these in various degrees. Further, when a
positioning request is initiated it is not known which
mechanisms will be needed during the course of the
location procedure, since this will depend on in which
PLMN the target MS is currently located, and the
35   capabilities of that PLMN.

These state of the art solutions require that all
PLMNs involved when positioning an MS must be able to
support the same positioning roaming mechanism/protocol.

As set out above, it is anticipated that this will not be the case. Therefore, it is apparent that inter-operability will be seriously jeopardized.

Also, it is anticipated that initiated but not
5   successful positioning requests will create excess traffic load and thereby jeopardize system performance.

Summary of the present invention

It is an object of the present invention to mitigate
10 the above described drawbacks of the prior art by provid-ing a method for a location service requested from an originating network to obtain the position of a mobile station when located in a current network, wherein said originating network and current network uses different
15 positioning mechanisms/protocols.

In order to achieve said object the invention pro-vides a method for obtaining the position of a mobile station in a communications system, wherein the current network of the mobile station is identified, and a
20 suitable positioning protocol is selected, based on the identified current network.

The invention also provides a system comprising means for working the method, which is characterised by a protocol controller configured to apply positioning
25 protocols for different communication networks for usage in communication with the networks, a processing component configured to identify the mobile station's current network, and based on the identified current network, select among said positioning protocols a suitable
30 positioning protocol for communication with the current network.

Brief description of the drawings

The following detailed description, given by way of
35 example and not intended to limit the present invention solely thereto, will best be appreciated in conjunction with the accompanying drawings, wherein like reference numerals denote like elements and parts, in which:

FIG 1 illustrates a system according to the
invention providing location service for positioning a
mobile station, wherein an originating network and a
current network uses different positioning

5   mechanisms/protocols, and
FIG 2 is a flow chart illustrating the method of
positioning a mobile station according to the invention.

Detailed description of the invention

10   With reference now to the figures wherein like or
similar elements are designated with identical reference
numerals, there is a block diagram and a flowchart
depicting the invention. The purpose of this diagram is to
illustrate the features of the invention and the basic

15   principles of operation of embodiments thereof. This
diagram is not necessarily intended to schematically
represent particular modules of circuitry or any
particular data or control paths. It should also be
emphasised that the terms "comprises" and "comprising"

20   when used in this specification is taken to specify the
presence of stated features, integers, steps or components
but does not preclude the presence or addition of one or
more other features, integers, steps, components or groups
thereof.

25   Figure 1 illustrates one embodiment of a
communication network configuration including a first
embodiment of the system according to the invention for
providing location services for positioning a subscriber
with a portable radio communication apparatus or equipment

30   such as a mobile telephone 1 when located in a current
network 6, wherein a home network 5 and the current
network 6 uses different positioning mechanisms/protocols.
The term portable radio communication equipment,
which herein after is referred to as a mobile radio

35   terminal or mobile phone includes but is not limited to
all equipment such as mobile telephones, pagers,
communicators, electronic organizers, smart phones or the
like.

The system configuration comprises a home Gateway
Mobile Location Centre (H-GMLC) 2 and a Serving Mobile
Location Centre (SMLC) 3. The GMLC is a vital part of a
mobile positioning system. The GMLC is the Ericsson
5   Gateway Mobile Positioning Centre (GMPC), which is
Ericsson's implementation of, but is not limited to, the
by ETSI standardised Gateway Mobile Location Centre
(GMLC). In one embodiment of the invention, the GMLC 2 is
a system that comprises at least a computer processor or
10 other processing component and a data store operatively
connected to the processing component.
     The GMLC 2 is the GSM/UMTS PLMN node to be accessed
by an external location services (LCS) client 4 when it
requests the location of a certain mobile station. The
15 GMLC 2 offers interfaces, XML/HTTP based in this
embodiment, through which the LCS client 4,4',4" and the
GMLC 2,2',2" can communicate, for example over an IP
network 7, e.g. the Internet. The communication includes
positioning requests from the LCS 4,4',4" client and
20 positioning answers from the GMLC 2,2',2". Each GMLC
2,2',2" is adapted to handle connections from multiple LCS
clients 4, and/or 4', and/or 4" simultaneously. Moreover,
the GMLC 2 performs, among other things, an authorization
check on the request.
25   The authorized request is delivered to the SMLC 3
via a PLMN 5, for example a GSM network. The SMLC 3
collects position information from the GSM network 5 and
calculates the location, such as co-ordinates, to be used
by the service or client 4. The location are delivered to
30 the GMLC 2, which is adapted to receive the location and
create a location response. This response is replied to
the requesting LCS-C 4.
     According to the invention, the GMLC 2 is adapted to
provide support for LCS where position needs to be
35 obtained for roaming terminals and/or terminals belonging
to other PLMNs 6. The GMLC 2 has information to
dynamically select a protocol, SS7 or IP-based in this
embodiment, to be used in the communication of positioning

data with each specific PLMN 5,6. Thus, based on roaming
capability information defined in the GMLC 2 for each
HPLMN 5 and VPLMN 6, the GMLC 2 is adapted to select the
proper protocol to be used when addressing the particular

5   PLMN 5, 6 with a positioning request or routing request.
The GMLC 2 is in this embodiment of the invention
configured, but not limited, to select between different
roaming protocols, for example SS7 based protocols, or IP
based protocols such as the GMLC-centric IP roaming

10   protocol or location middleware (LMw) centric IP roaming
protocols. It should therefore be apparent to those
skilled in the art that the invention is not limited to be
employed in an GMLC but could also be located in for
example a location middleware. Also, in one embodiment LMw

15   is used as an interconnect layer between LCS clients and
GMLCs. In a such embodiment, network to network
communication may be performed between LMw nodes.

One SS7 protocol is defined in the LCS standards
Stage 2 GSM TS 03.71, v 8.2.0 and GSM TS 29.002 which are

20   enclosed herein by reference. One IP based roaming
protocol is the MLP 3.0.0 developed by Location Inter-
operability Forum (LIF) which is enclosed herein by
reference.

A flow chart in FIG 2 illustrates one embodiment of

25   a method of positioning a subscriber according to the
invention. In step 101 the LCS client 4 sends a positio-
ning request to the GMLC 2. The GMLC receives the request
in step 102, analyses and identifies the subscriber's home
PLMN (HPLMN) 5 in an LCS signalling list in step 103. Said

30   LCS signalling list comprises entries, each including a
network identifier and a protocol. Based on the result
from the identification and analysis in step 103, a
suitable positioning protocol, for example SS7, is
selected for communication with the home PLMN in step 104.

35   A routing information request is sent to the home PLMN 5
in step 105 and an answer is received by the GMLC 2 from
the PLMN 5 in step 106.

When the GMLC 2 has received the answer it analyses the parameter data and identifies the subscriber's current PLMN in the LCS signalling list in step 107. In this example the MS 1 is roaming in a visited PLMN 6. Based on the result from the identification and analysis in step 107, a suitable positioning protocol, for example an IP based protocol using the IP network 7, is selected for communication with the visited PLMN 6 in step 108. A position request is sent to the visited PLMN 6 in step 109 and an answer including co-ordinates and/or other location information about the roaming subscriber and its apparatus 1 is received by the GMLC 2 from the VPLMN 6 in step 110.

Finally, the GMLC 2 creates a position response and replies it to the requesting LCS-C 4 in step 111.

The method, system and apparatus according to the invention is however not limited to positioning of roaming MSs, but are capable of positioning MSs in all cases involving positioning related communication between PLMNs. One example of a traffic case where such communication is needed is when an LCS client 4" using an originating GMLC (O-GMLC) 2" and needs to locate an MS which is a subscriber to another PLMN than an OPLMN (Originating PLMN) 8, independently on whether the MS is roaming outside its home PLMN or not. Another such traffic case occurs when an MS 1 is currently located in its home network HPLMN 5 or a visited network VPLMN 6 but accesses a location based service, using another LCS-C (4") associated with an originating GMLC (O-GMLC) (2").

In addition, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice when executed on a computer. The program may be in the form of source code, object code a code suitable for use in the implementation of the method according to the invention. The carrier can be any entity or device capable of carrying the program. For example the carrier may be a record medium, computer memory, read-only memory or an electrical carrier signal.

Although one embodiment of the method, system and apparatus of the invention has been illustrated in the accompanying drawings and described in the foregoing detailed description, it will be understood that the

5   invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

10

CLAIMS

1. A method for obtaining the position of a mobile
station (1) located in a current network of a
5   communications system including a plurality of networks
supporting different positioning protocols, **characterised**
by the steps of:
       identifying at a location centre (2, 2', 2") the
current network (6)(107) of said mobile station,
10   based on said identified current network (6),
selecting among at least two protocols a suitable
positioning protocol for communication of location
information with said current network (6)(108).

15   GLÖM INTE SYSTEM KRAV!
2. A method according to claim 1, **characterised** by
before the steps of identifying the current network
(6)(107) of the mobile station, the further steps of:
       receiving at said location centre a positioning
20   request (102),
       identifying the subscriber's home network (5)(103),
       based on said identified home network (5), selecting
a suitable positioning protocol for communication with
said home network (5)(104),
25   sending a routing information request to the home
network (5)(105),
       receiving an answer from the home network (5)(106),
and
       analysing the answer for identifying the current
30   network (6) of the mobile station (107).

3. A method according to claim 1 or 2, **characterised**
by the further steps of:
       sending a position information request to the
35   current network (6)(109), and
       receiving an answer including location information
about the subscriber (1) from the current network
(6)(110).

4. A method according to any of the preceding claims, **characterised** in that any of the SS7 protocol, MLP or IP roaming protocol is selected.

5

5. A system for obtaining the position of a mobile station (1) located in a current network of a communications system including a plurality of networks supporting different positioning protocols, **characterised**

10   by:

a processing component configured to:

identify the current network (6)(107) of the mobile station, and

based on said identified current network (6), select

15   among at least two protocols a suitable positioning protocol for communication of location information with said current network (6)(108).

6. A system according to claim 5, **characterised**

20   by a receiving component and a sending component, wherein said receiving component is configured to receive a positioning request (102) from an location services (LCS) client (4,4',4"),

said processing component is configured to identify

25   a home network (5)(103) for the subscriber (1); based on said identified home network (5), select a suitable positioning protocol from said positioning protocols for communication with said home network (5)(104),

said sending component is configured to send a

30   routing information request to the home network (5)(105),

said receiving component is configured to receive an answer from the home network (5)(106), and

said processing component is configured to analyse the answer for identifying the current network (6)(107) of

35   the mobile station (1).

7. A system according to claim 5 or 6, **characterised** in that said sending component is configured to send a

routing information request to the visited network
(6)(109), and

said receiving component is configured to receive an
answer including location information about the roaming
5   subscriber (1) from the visited network (6)(110).

8. A system according to any of the claims 5-7,
characterised in that said positioning protocols are any
of the SS7 protocol, and/or GMLC-centric IP roaming
10   protocol and/or location middleware IP roaming protocol.

9. A computer program comprising program
instructions for causing a computer to perform the method
of any of the claims 1-4.
15

10. A computer program on a carrier and comprising
computer executable instructions for causing a computer to
perform the method according to claims 1-4.

20   11. A computer program according to claim 10,
wherein said carrier is a record medium, computer memory,
read-only memory or an electrical carrier signal.
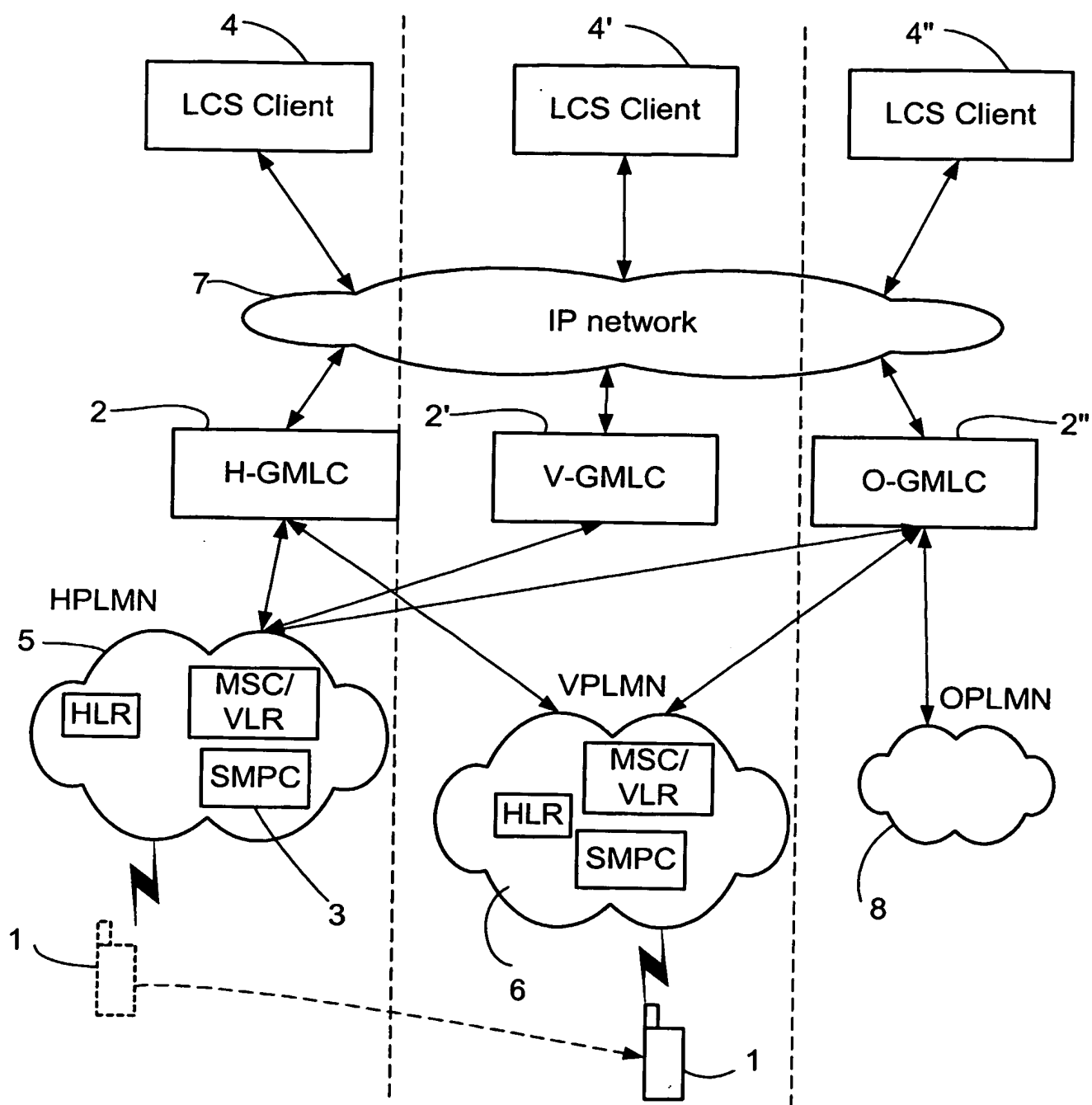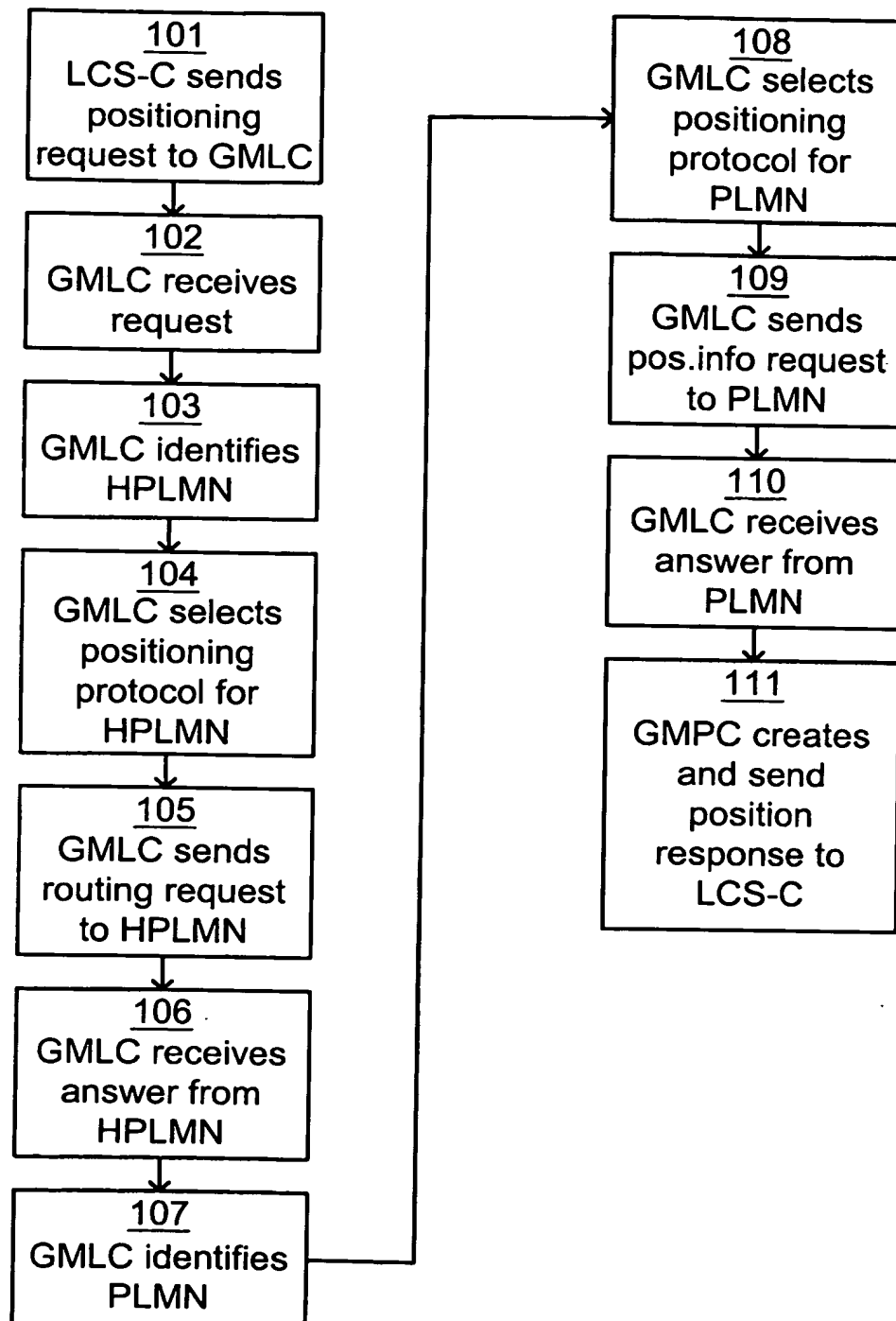
FIG. 1

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 02/02308

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2001003093 A1 (MAGNUS LUNDIN), 7 June 2001 (07.06.01), abstract, page 1 paragraph [6] – paragraph[11]; page 2 paragraph [21] – paragraph [29]	1-11
A	WO 9946948 A1 (ERICSSON INC.), 16 Sept 1999 (16.09.99), page 6, line 13 – page 9, line 6	1-11
E,X	WO 03039187 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 8 May 2003 (08.05.03), page 2 – page 6, abstract	1-11

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

26 June 2003

Date of mailing of the international search report

3 0 -06- 2003

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Form PCT/ISA/210 (second sheet) (July 1998)

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